We claim:

1 A method of making a desired one piece seal element having a hinge-groove on primary sealing lip that uses a tubular/cylindrical billet of plastic having an outside diameter (OD) slightly greater than that of the desired seal element and an inside diameter (ID) slightly smaller than that of the desired seal element, and

that uses a machine capable of rotation that includes a plunge cut tool, and a cut off tool, comprising the steps of:

initializing the billet by

procuring billets of a desired plastic;

mounting, as by clamping, the billet into the machine with the center axis of the billet close to being coaxial with the center rotational axis of the machine;

rotating the machine;

effecting an open face on the billet if an open face is not already present;

machining the OD and ID of the mounted billet so that its OD and ID are essentially the same as that of the desired seal element;

machining seal elements by cycling the steps of

moving the plunge cut tool against said open face of the rotating-mounted billet to machine a shallow, circular hinge groove; and

severing seal element from the billet by bringing cut off tool downward towards said rotational axis.

2 A method of claim 1 wherein said desired plastic of said procuring step comprises a polytetrafluoroethylene mixture.

3 A method of claim 2 wherein said polytetrafluoroethylene mixture consists, by weight, of approximately 90% virgin polytetrafluoroethylene, 5% fiber-glass, and 5% molybdenum disulfide.

4 A method of making a desired one piece seal element having a hinge-groove, and a wiper lip on primary sealing lip

that uses a tubular/cylindrical billet of plastic having an outside diameter (OD) slightly greater than that of the desired seal element and an inside diameter (ID) slightly smaller than that of the desired seal element, and

that uses a machine capable of rotation that includes a plunge cut tool, a single point tool, and a cut off tool, comprising the steps of:

initializing the billet by

procuring billets of a desired plastic;

mounting, as by clamping, the billet into the machine with the center axis of the billet close to

being coaxial with the center rotational axis of the machine;

rotating the machine;

effecting an open face on the billet if an open face is not already present;

machining the OD and ID of the mounted billet so that its OD and ID are essentially the same as that of the desired seal element;

machining seal elements by cycling the steps of

moving the plunge cut tool against said open face of the rotating-mounted billet to machine a shallow, circular hinge groove;

moving plunge cut tool away from said open face of the rotating-mounted billet and then moving plunge cut tool closer to the center rotational axis of the machine than said hinge groove where it is desired to begin to form wiper lip;

moving plunge cut tool against said open face of the rotating-mounted billet to machine a shallow, circular groove and then withdrawing plunge cut tool from said open face;

replacing plunge cut tool with single point tool;

moving single point tool into said open face a distance essentially equal to the desired thickness of the desired wiper lip at the position from which plunge cut tool was just withdrawn;

moving single point tool away from the rotational axis of the machine stopping prior to reaching said hinge groove, whereby wiper lip is effected;

withdrawing single point tool from said open face; and

severing seal element from the billet by bringing cut off tool downward towards said rotational axis.

5 A method of claim 4 wherein said desired plastic of said procuring step comprises a polytetrafluoroethylene mixture.

6 A method of claim 5 wherein said polytetrafluoroethylene mixture consists, by weight, of approximately 90% virgin polytetrafluoroethylene, 5% fiber-glass, and 5% molybdenum disulfide.

7 A method of making a desired one piece seal element having a hinge-groove, and a wiper lip on primary sealing lip

that uses a tubular/cylindrical billet of plastic having an outside diameter (OD) slightly greater than that of the desired seal element and an inside diameter (ID) slightly smaller than that of the desired seal element, and

that uses a machine capable of rotation that includes a plunge cut tool with two spaced-apart cutters, a single point tool, and a cut off tool, comprising the steps of:

initializing the billet by

procuring billets of a desired plastic;

mounting, as by clamping, the billet into the machine with the center axis of the billet close to being coaxial with the center rotational axis of the machine;

rotating the machine;

effecting an open face on the billet if an open face is not already present;

machining the OD and ID of the mounted billet so that its OD and ID are essentially the same as that of the desired seal element;

machining seal elements by cycling the steps of

moving the plunge cut tool against said open face of the rotating-mounted billet to machine a shallow, circular hinge groove and to machine a second shallow, circular groove closer to the center rotational axis of the machine than said hinge groove where it is desired to begin to form wiper lip;

replacing plunge cut tool with single point tool;

moving single point tool into said open face a distance essentially equal to the desired thickness of the desired wiper lip at the position of said second shallow, circular groove;

moving single point tool away from the rotational axis of the machine stopping prior to reaching said hinge groove, whereby wiper lip is effected;

withdrawing single point tool from said open face; and

severing seal element from the billet by bringing cut off tool downward towards said rotational axis.

8 A method of claim 7 wherein said desired plastic of said procuring step comprises a polytetrafluoroethylene mixture.

9 A method of claim 8 wherein said polytetrafluoroethylene mixture consists, by weight, of approximately 90% virgin polytetrafluoroethylene, 5% fiber-glass, and 5% molybdenum disulfide.

10 A method of making a desired one piece seal element having a hinge-groove and hydro-thread on primary sealing lip

that uses a tubular/cylindrical billet of plastic having an outside diameter (OD) slightly greater than that of the desired seal element and an inside diameter (ID) slightly smaller than that of the desired seal element, and

that uses a machine capable of rotation that includes a plunge cut tool, a single point tool, and a cut off tool, comprising the steps of:

initializing the billet by

procuring billets of a desired plastic;

mounting, as by clamping, the billet into the machine with the center axis of the billet close to being coaxial with the center rotational axis of the machine;

rotating the machine;

effecting an open face on the billet if an open face is not already present;

machining the OD and ID of the mounted billet so that its OD and ID are essentially the same as that of the desired seal element;

machining seal elements by cycling the steps of

moving the plunge cut tool against said open face of the rotating-mounted billet to machine a shallow, circular hinge groove;

replacing plunge cut tool with single point tool;

cutting hydrodynamic grooves in the form of a spiral, as seen looking into said open face, by moving single point tool into said open face a fixed distance while moving single point tool radially across a portion of said open face, whereby hydro-thread is effected;

withdrawing single point tool from said open face; and

severing seal element from the billet by bringing cut off tool downward towards said rotational axis.

11 A method of claim 10 wherein said desired plastic of said procuring step comprises a polytetrafluoroethylene mixture.

12 A method of claim 11 wherein said polytetrafluoroethylene mixture consists, by weight, of approximately 90% virgin polytetrafluoroethylene, 5% fiber-glass, and 5% molybdenum disulfide.

13 A method of claim 10 wherein said portion of said step of moving single point tool radially across a portion of said open face that is part of said step of cutting hydrodynamic grooves includes said ID of the billet, whereby the resultant hydrodynamic grooves extend to the toe of the resultant seal element.

14 A method of claim 13 wherein said portion extends from said ID of the billet to said hinge groove.

15 A method of claim 13 wherein said portion extends from said ID of the billet to short of said hinge groove.

16 A method of claim 10 wherein said portion of said step of moving single point tool radially across a portion of said open face that is part of said step of cutting hydrodynamic grooves does not include said ID of the billet, whereby the resultant hydrodynamic grooves do not extend to the toe of the resultant seal element.

17 A method of making a desired one piece seal element having a hinge-groove, a wiper lip, and hydro-thread on primary sealing lip

that uses a tubular/cylindrical billet of plastic having an outside diameter (OD) slightly greater than that of the desired seal element and an inside diameter (ID) slightly smaller than that of the desired seal element, and

that uses a machine capable of rotation that includes a plunge cut tool, a single point tool, and a cut off tool, comprising the steps of:

initializing the billet by

procuring billets of a desired plastic;

mounting, as by clamping, the billet into the machine with the center axis of the billet close to being coaxial with the center rotational axis of the machine;

rotating the machine;

effecting an open face on the billet if an open face is not already present;

machining the OD and ID of the mounted billet so that its OD and ID are essentially the same as that of the desired seal element;

machining seal elements by cycling the steps of

moving the plunge cut tool against said open face of the rotating-mounted billet to machine a shallow, circular hinge groove;

moving plunge cut tool away from said open face of the rotating-mounted billet and then moving plunge cut tool closer to the center rotational axis of the machine than said hinge groove where it is desired to begin to form wiper lip;

moving plunge cut tool against said open face of the rotating-mounted billet to machine a shallow, circular groove and then withdrawing plunge cut tool from said open face;

replacing plunge cut tool with single point tool;

moving single point tool into said open face a distance essentially equal to the desired thickness of the desired wiper lip at the position from which plunge cut tool was just withdrawn;

moving single point tool away from the rotational axis of the machine stopping prior to reaching said hinge groove, whereby wiper lip is effected;

withdrawing single point tool from said open face;

cutting hydrodynamic grooves in the form of a spiral, as seen looking into said open face, by moving single point tool into said open face a fixed distance while moving single point tool radially across a portion of said open face, whereby hydro-thread is effected;

withdrawing single point tool from said open face; and

severing seal element from the billet by bringing cut off tool downward towards said rotational axis.

18 A method of claim 17 wherein said desired plastic of said procuring step comprises a polytetrafluoroethylene mixture.

19 A method of claim 18 wherein said polytetrafluoroethylene mixture consists, by weight, of approximately 90% virgin polytetrafluoroethylene, 5% fiber-glass, and 5% molybdenum disulfide.

20 A method of claim 17 wherein said portion of said step of moving single point tool radially across a portion of said open face that is part of said step of cutting hydrodynamic grooves includes said ID of the billet, whereby the resultant hydrodynamic grooves extend to the toe of the resultant seal element.

21 A method of claim 20 wherein said portion extends from said ID of the billet to said wiper lip.

22 A method of claim 20 wherein said portion extends from said ID of the billet to short of said wiper lip, whereby the resultant hydrodynamic grooves do not extend to the heel of the resultant seal element.

23 A method of claim 17 wherein said portion of said step of moving single point tool radially across a portion of said open face that is part of said step of cutting hydrodynamic grooves does not include said ID of the billet, whereby the resultant hydrodynamic grooves do not extend to the toe of the resultant seal element.

24 A method of making a desired one piece seal element having a hinge-groove, a wiper lip, and hydro-thread on primary sealing lip

that uses a tubular/cylindrical billet of plastic having an outside diameter (OD) slightly greater than that of the desired seal element and an inside diameter (ID) slightly smaller than that of the desired seal element, and

that uses a machine capable of rotation that includes a plunge cut tool with two spaced-apart cutters, a single point tool, and a cut off tool, comprising the steps of:

initializing the billet by

procuring billets of a desired plastic;

mounting, as by clamping, the billet into the machine with the center axis of the billet close to being coaxial with the center rotational axis of the machine;

rotating the machine;

effecting an open face on the billet if an open face is not already present;

machining the OD and ID of the mounted billet so that its OD and ID are essentially the same as that of the desired seal element;

machining seal elements by cycling the steps of

moving the plunge cut tool against said open face of the rotating-mounted billet to machine a shallow, circular hinge groove and to machine a second shallow, circular groove closer to the center rotational axis of the machine than said hinge groove where it is desired to begin to form wiper lip;

replacing plunge cut tool with single point tool;

moving single point tool into said open face a distance essentially equal to the desired thickness of the desired wiper lip at the position of said second shallow, circular groove;

moving single point tool away from the rotational axis of the machine stopping prior to reaching said hinge groove, whereby wiper lip is effected;

withdrawing single point tool from said open face;

cutting hydrodynamic grooves in the form of a spiral, as seen looking into said open face, by moving single point tool into said open face a fixed distance while moving single point tool radially across a portion of said open face, whereby hydro-thread is effected;

withdrawing single point tool from said open face; and

severing seal element from the billet by bringing cut off tool downward towards said rotational axis.

25 A method of claim 24 wherein said desired plastic of said procuring step comprises a polytetrafluoroethylene mixture.

26 A method of claim 25 wherein said polytetrafluoroethylene mixture consists, by weight, of approximately 90% virgin polytetrafluoroethylene, 5% fiber-glass, and 5% molybdenum disulfide.

27 A method of claim 24 wherein said portion of said step of moving single point tool radially across a portion of said open face that is part of said step of cutting hydrodynamic grooves includes said ID of the billet, whereby the resultant hydrodynamic grooves extend to the toe of the resultant seal element.

28 A method of claim 27 wherein said portion extends from said ID of the billet to said wiper lip.

29 A method of claim 27 wherein said portion extends from said ID of the billet to short of said wiper lip, whereby the resultant hydrodynamic grooves do not extend to the heel of the resultant seal element.

30 A method of claim 24 wherein said portion of said step of moving single point tool radially across a portion of said open face that is part of said step of cutting hydrodynamic grooves does not include said ID of the billet, whereby the resultant hydrodynamic grooves do not extend to the toe of the resultant seal element.

31 An improved housed shaft sealing element that has a flex area between the part of the sealing element to bear on the shaft and the part of the sealing element clamped in the housing, wherein the improvement comprises:

a flex area that is thinner than the thickness of the part of the sealing element bearing on the shaft.

32 An improved housed shaft sealing element according to claim 31, further including adjusting the thickness of said flex area to effect a desired pressure on the shaft by the part of the sealing element bearing on the shaft.

33 An improved housed shaft sealing element according to claim 31, further including a flex area that is thinner than the thickness of the part of the sealing element clamped in the housing.

34 An improved housed shaft sealing element that has a flex area between the part of the sealing element to bear on the shaft and the part of the sealing element clamped in the housing, wherein the improvement comprises:

hydrodynamic grooves that extend across a portion of the part of the sealing element bearing on the shaft that includes the ID of the part of the sealing element bearing on the shaft.

35 An improved housed shaft sealing element according to claim 34, further including extending said hydrodynamic grooves into the flex area to effect a desired pressure on the shaft by the part of the sealing element bearing on the shaft.

36 An improved housed shaft sealing element according to claim 34, wherein the depth of said hydrodynamic grooves is set so as to effect a desired pressure on the shaft by the part of the sealing element bearing on the shaft.

37 An improved housed shaft sealing element according to claim 34, wherein the pitch of said hydrodynamic grooves is set so as to effect a desired pressure on the shaft by the part of the sealing element bearing on the shaft.

38 An improved housed shaft sealing element according to claim 34, further including extending said hydrodynamic grooves short of the portion of the part of the sealing element bearing on the shaft that is distant from the ID of the part of the sealing element bearing on the shaft, whereby a static sealing band is effected.

39 An improved housed shaft sealing element that has a flex area between the part of the sealing element to bear on the shaft and the part of the sealing element clamped in the housing, wherein the improvement comprises:

hydrodynamic grooves that extend across a portion of the part of the sealing element bearing on the shaft that does not include the ID of the part of the sealing element bearing on the shaft.

40 An improved housed shaft sealing element according to claim 39, further including extending said hydrodynamic grooves into the flex area to effect a desired pressure on the shaft by the part of the sealing element bearing on the shaft.

41 An improved housed shaft sealing element according to claim 39, wherein the depth of said hydrodynamic grooves is set so as to effect a desired pressure on the shaft by the part of the sealing element bearing on the shaft.

42 An improved housed shaft sealing element according to claim 39, wherein the pitch of said hydrodynamic grooves is set so as to effect a desired pressure on the shaft by the part of the sealing element bearing on the shaft.

43 An improved housed shaft sealing element according to claim 39, further including extending said hydrodynamic grooves short of the portion of the part of the sealing element bearing on the shaft that is distant from the ID of the part of the sealing element bearing on the shaft, whereby

a static sealing band is effected.

44 An improved housed shaft sealing element that has a flex area between the part of the sealing element to bear on the shaft and the part of the sealing element clamped in the housing, wherein the improvement comprises:

a circumferential hinge groove in the flex area having a depth less than the thickness of the sealing element in the flex area.

45 An improved housed shaft sealing element according to claim 44, further including adjustment of said depth of said hinge groove to effect a desired pressure on the shaft by the part of the sealing element bearing on the shaft.

46 An improved housed shaft sealing element according to claim 44, further including adjustment of the position of said hinge groove within the flex area to effect a desired pressure on the shaft by the part of the sealing element bearing on the shaft.

47 An improved housed shaft sealing element according to claim 44, further including a wiper lip.

48 An improved housed shaft sealing element according to claim 47, further including adjustment of said depth of said hinge groove to effect a desired pressure on the shaft by the part of the sealing element bearing on the shaft.

49 An improved housed shaft sealing element according to claim 47, further including adjustment of the position of said hinge groove within the flex area to effect a desired pressure on the shaft by the part of the sealing element bearing on the shaft.

50 An improved housed shaft sealing element according to claim 47, further including an ID of said wiper lip that is greater than the OD of the shaft.

51 In the crafting of an improved housed shaft sealing element that has a flex area between the part of the sealing element to bear on the shaft and the part of the sealing element clamped in the housing, a method for adjusting the pressure on the shaft by the part of the sealing element bearing on the shaft comprising the steps of:

selecting one or more methods of effecting the stiffness of the flex area selected from the group consisting of

thinning the material in the flex area,

cutting a circumferential hinge groove in the vicinity of the flex area,

picking the pitch and depth of hydrodynamic grooves,

extending hydrodynamic grooves into the flex area, and

tapering the thickness of the part of the seal bearing on the shaft; and

implementing the selected methods.

52 The method of claim 51 further including the step of cutting hydrodynamic grooves that extend across a portion of the part of the sealing element bearing on the shaft that does not include the

ID of the part of the sealing element bearing on the shaft.

53 In the crafting of an improved housed shaft sealing element that has a flex area between the part of the sealing element to bear on the shaft and the part of the sealing element clamped in the housing, a method for optimizing performance of the sealing element comprises the steps of:

selecting one or more methods of effecting the stiffness of the flex area selected from the group consisting of

thinning the material in the flex area,

cutting a circumferential hinge groove in the vicinity of the flex area,

picking the pitch and depth of hydrodynamic grooves,

extending hydrodynamic grooves into the flex area, and

tapering the thickness of the part of the seal bearing on the shaft, whereby the pressure on the shaft by the part of the sealing element bearing on the shaft is optimized;

implementing the selected methods; and

providing a wiper lip.

54 The method of claim 53 further including the step of cutting hydrodynamic grooves that extend across a portion of the part of the sealing element bearing on the shaft that does not include the ID of the part of the sealing element bearing on the shaft.

55 An improved housed shaft sealing element that has a flex area between the part of the sealing element to bear on the shaft and the part of the sealing element clamped in the housing, wherein the improvement comprises:

tapering the thickness of the part of the seal bearing on the shaft.

56 An improved housed shaft sealing element according to claim 55, wherein said tapering is most thick near the flex area.

57 An improved housed shaft sealing element according to claim 55, wherein said tapering is least thick near the flex area.

58 An improved housed shaft sealing element according to claim 55 further including a circumferential hinge groove in the flex area having a depth less than the thickness of the sealing element in the flex area.

59 An improved housed shaft sealing element according to claim 58, further including adjustment of said depth of said hinge groove to effect a desired pressure on the shaft by the part of the sealing element bearing on the shaft.

60 An improved housed shaft sealing element according to claim 58, further including adjustment of the position of said hinge groove within the flex area to effect a desired pressure on the shaft by the part of the sealing element bearing on the shaft.

61 An improved housed shaft sealing element according to claim 58, further including a wiper lip.

62 An improved housed shaft sealing element according to claim 61, further including adjustment of said depth of said hinge groove to effect a desired pressure on the shaft by the part of the sealing element bearing on the shaft.

63 An improved housed shaft sealing element according to claim 61, further including adjustment of the position of said hinge groove within the flex area to effect a desired pressure on the shaft by the part of the sealing element bearing on the shaft.

64 An improved housed shaft sealing element according to claim 61, further including an ID of said wiper lip that is greater than the OD of the shaft.

65 An improved housed shaft sealing element according to claim 55 further including hydrodynamic grooves that extend across a portion of the part of the sealing element bearing on the shaft.

66 An improved housed shaft sealing element according to claim 65, further including extending said hydrodynamic grooves into the flex area to effect a desired pressure on the shaft by the part of the sealing element bearing on the shaft.

67 An improved housed shaft sealing element according to claim 65, wherein the depth of said hydrodynamic grooves is set so as to effect a desired pressure on the shaft by the part of the sealing element bearing on the shaft.

68 An improved housed shaft sealing element according to claim 65, wherein the pitch of said hydrodynamic grooves is set so as to effect a desired pressure on the shaft by the part of the sealing element bearing on the shaft.

69 An improved housed shaft sealing element according to claim 55 further including a circumferential hinge groove in the flex area having a depth less than the thickness of the sealing element in the flex area and hydrodynamic grooves that extend across a portion of the part of the sealing element bearing on the shaft.

70 An improved housed shaft sealing element according to claim 55 further including

a circumferential hinge groove in the flex area having a depth less than the thickness of the sealing element in the flex area;

hydrodynamic grooves that extend across a portion of the part of the sealing element bearing on the shaft; and

a wiper lip.